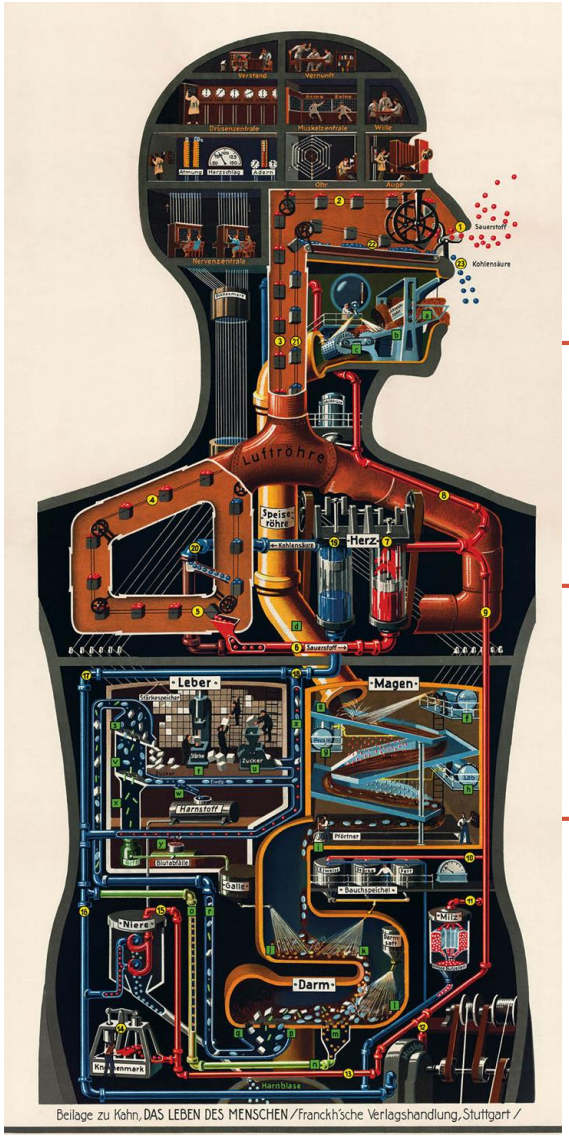


Fritz Kahn (1888 – 1968)

BIOMECHANICS

Practical Course Introduction

7ο εξάμηνο

Σχολή Μηχανολόγων Μηχανικών ΕΜΠ

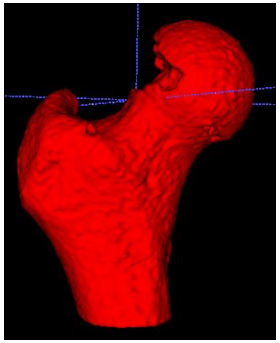
Διδάσκων:
Michael Neidlin

Practical course structure

CT data provided

Segmentation/
smoothing

Homework II



STL model
of femur

Material models (in vitro tests from literature)

Loading conditions (Forces acting on the femur head)

P: 70➔180 kg
Standing and jumping

FEA analysis
in PC lab

Short report
with results
(in groups)

Homework IV

Image Data

Data stored on Dropbox

https://www.dropbox.com/s/o7acwhgv7q8d4v8/Bone_CT_high.tar.gz?dl=0

#1: High resolution CT data ~1.5 GB (somehow there is an error in the end of extraction, but file works fine!)

https://mrl.sci.utah.edu/software/hip-data/ ➔ more data stored, if there are problems. I downloaded patient 9.

https://www.dropbox.com/s/oujky4lij576liq/Bone_CT_low.nrrd?dl=0

#2: Lower resolution CT data ~130 MB

Should also work. High res data needs some RAM to post-process.

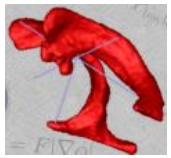
Software – Image Segmentation

Image segmentation (open-source):

You are free to choose. Two suggestions

3dslicer https://www.slicer.org/

ITK snap http://www.itksnap.org/



There are tutorials and background information on both websites.
Also check out youtube
(3d slicer segmentation, itk snap) ;
here you will find many videos that go beyond the tutorials.

ITK Snap is a bit spartanic, but also not that overloaded. 3D Slicer is used a **lot**, so that might be a good program to have knowledge about.

Software – STL post-processing

After STL export you need to look at your model and post-process it.

Inspecting, smoothing and closing of small holes to retrieve a clean geometry for FE analysis.

Autodesk Meshmixer

http://www.meshmixer.com/ 

MeshLab (rather complicated ?) 

http://www.meshlab.net/

Also other STL editors possible (SketchUp...). Youtube has again many videos. E.g. Meshmixer smoothing, hole closing etc.

Aims of homework

- Get used to working with imaging data
- Segment one femur (right or left, but remember which one)
- Post-process and smooth the STL ➔ Model for FEA
- Send STL to neidlin@central.ntua.gr via https://wetransfer.com/

- Additional tasks:
  - Look for material models and in vitro tests of cortical bone
  - Look for information on bone loading (70-180kg, stand/jump)
  - A conversion from STL to a CAD format (IGES or STEP) is **highly** beneficial when you want to do FEA. Geometrical irregularities often omit this step. Solidworks or FreeCAD (?)

- You are also **highly encouraged** to come up with an own small research question that could be answered with FEA. Do not make **it too complicated** due to limited time.

Troubleshooting guide

As this is the first time we are doing this, many things can go wrong.

Don’t worry if segmentation does not work out (maybe a little bit if you are the only one ☺), we have a plan B.

The learning aim is to get familiar with the process in a **close-to-real-world-scenario** where the we provide you with a task and you have to come up with a solution by yourself or in teams.